
# Varian Associates: An Early History

# INTRODUCTION

ON April 20, 1948, the Secretary of State of California affixed the Great Seal of the State to the Articles of Incorporation of Varian Associates.

The articles were signed by nine persons who were named as directors of the new corporation; they were: Edward L. Ginzton, William W. Hansen, Richard M. Leonard, Leonard I. Schiff, H. Myrl Stearns, Dorothy Varian, Russell H. Varian, Sigurd F. Varian, and Paul B. Hunter.

The articles of incorporation stated in part that the purposes of the new Company were to "conduct general research in the fields of physical science of every kind or nature, including . . . heat, sound, light, optics, x-rays, charged particles, ionizing radiations, electricity, magnetism, properties of solids, liquids and gases, vacuum technology and applications thereof, chemistry including physical chemistry, electro-chemistry and metallurgy, to engage in the evaporation of substances in an evacuated chamber, to accelerate charged particles to high kinetic energies, to measure the gyro-magnetic ratio of nuclei of atoms, to use the gyro-magnetic properties of atoms to measure magnetic fields or for other purposes . . ." — that is to say vacuum products, NMR and EPR spectrometers, linear accelerators, optical spectrometers, and more.

In support of this ambitious undertaking were $22,000 of capital, and six full-time employees — the Varian brothers, Dorothy, Myrl Stearns, Fred Salisbury, and Don Snow. In addition, Edward Ginzton, Marvin Chodorow, William Hansen and Leonard Schiff, all of whom were on the faculty at Stanford, supplied technical and business assistance. Dick Leonard, a San Francisco attorney, was legal counsel, while Paul Hunter, a patent attorney, was the protector of ideas.

The articles of incorporation, which ran to 15 pages, described seven lines of business including the development and manufacture of: ". . . evacuated or gas-filled envelopes for, or for use in the production, generation . . . of electricity . . . and of radiation . . ." — in other words, electron tubes.

". . . circuits, and other means of assembling or using any of the foregoing elements and principles for radio, radar, television . . ." — a description of our involvement in three major markets.

The nine directors did not gather together to sign the articles. Dick Leonard's signature was notarized in San Francisco. Myrl Stearns, Sig Varian, and Paul Hunter were still in the East, and they signed in Nassau County, Long Island. They were joined by Ed Ginzton who was in the New York area on business.

Before Bernice Ewell, Notary Public for the County of Santa Clara, gathered Russ and Dorothy Varian, Leonard Schiff, and William Hansen. Assuming that Bernice Ewell had read the document, she must have thought them somewhat mad.

Nonetheless, today, Varian Associates can look back at its articles of incorporation and say, in effect, "Sure, that's what we said we were going to do, and that's about what we did." Lines of business described in 1948 are major technologies, benefiting not only Varian, but companies around the world, accounting for annual sales in the billions of dollars, and jobs counted in the tens of thousands.

About 1949, the directors and a few other early employees posed before the "headquarters" in San Carlos. Some years later, a senior officer of Varian regarded that photo and asked: "If that group came to you and asked for financial backing, would you give them a nickel?"

Although it is clear from the articles of incorporation that the founders

*Cover: In 1949, Varian's "headquarters" building was a leased facility in San Carlos, California. By the early 1950's, the company had moved to the Stanford Industrial Park in Palo Alto, California.*

*The first microwave radar system, with a klystron acting as the power source.*

planned a diversified enterprise, it was several years before Varian was essentially anything but a microwave tube plant.

However, the founders of Varian did not envision a one-product company, and they had intentionally settled near Stanford in order to enjoy the benefits of interchange with the various scientific programs in progress at the University. It happened that the early years of Varian coincided with an unusually rich period of invention at Stanford, and the young Company was to be a beneficiary of much of this productivity.

For example, Felix Bloch, William Hansen, and others had recently completed pioneering work in nuclear magnetic resonance. Varian obtained patent rights for NMR — the jumping-off point for Varian's present position as a leader in analytical instrumentation.

Also at Stanford, Hansen and Ginzton were building the first linear accelerators for high energy physics research. Today, Varian is the world leader in the production of linear accelerators.

*William Hansen at Stanford with the first linear accelerator.*

Gradually, facilities were moved from leased quarters in San Carlos to a quiet corner of Stanford land, thus creating what is today the Company's headquarters site, and incidentally bringing into being the Stanford Industrial Park — the most successful complex of its kind in the world.

Tubes, an expanding instrument line, an embryonic accelerator activity, and a venture into geophysical instruments marked Varian's activities as it neared the end of its first decade. In the mid 1950s, "a better mousetrap" was needed in the manufacture of tubes, and an all-electronic vacuum pump was invented. It was soon recognized that this device had applications far beyond tube processing, and another line of business was launched.

*Stanford laboratory where klystron development took place.*

It was a San Francisco Peninsula company until the early 1950s. Then the Canadian government asked Varian to create a local source for microwave tube production, and Varian Associates of Canada Limited was established in Georgetown, Ontario.

In 1959, S-F-D Laboratories was launched in Union, New Jersey, to design and build new classes of magnetrons and other tubes. And also in 1959, the first acquisition was made. Varian purchased Bomac Laboratories, a Massachusetts-based maker of tubes and components. Both S-F-D and Bomac are now the Beverly Division.

As the Company entered the 1960s, instruments and vacuum products were becoming major businesses, while a standard line of medical linear accelerators was developed and aggressively marketed. Research in solid state devices, new forms of printing, and devices for commercial communications also accelerated.

*Founders and close associates in San Carlos, California, left to right: Russ Varian, Sig Varian, Marvin Chodorow, Dorothy Varian, Dick Leonard, Esther Salisbury, Ed Ginzton, Fred Salisbury, Don Snow, and Myrl Stearns.*

Acquisitions played an equally major role in broadening Varian's product line. The largest of these was the merger of Eitel-McCullough, Inc., into Varian in 1965. With Eimac came a broad line of specialty electron tubes, sold primarily to various broadcast and industrial markets.

Four instrument companies joined Varian in the late 1960s — two in California, one in Australia, and one in Germany. These expanded our ability to serve the chemist and life scientist with the Aerograph line of gas and liquid chromatographs, the Techtron line of atomic absorption instruments, Cary spectrophotometers, and MAT mass spectrometers — all famous names in laboratories and clinics about the world.

These are the high points, and it is not our intention to write a detailed early history. Instead, we would like to talk about a few significant lines of business which seem to characterize the kind of company Varian is, and the kinds of people who have made it that way.

SAVE

## INVENTION OF THE KLYSTRON

**By E. L. Ginzton**

*An entry from Russell Varian's notebook, July 21, 1937.*

*Russ Varian (r) and Sig Varian (l) with klystron.*

*Surrounding the first klystron are: (background, l to r) Sig Varian, Prof. David Webster, Prof. William Hansen, (foreground) Russ Varian, and John Woodyard.*

*Surrounding an early klystron are (l to r) Al Miller, Bob Dunckel, Don Huncecker, Leo Hofmeister, Sam Federico, and Dick Walters.*

I first met Russell Varian in 1939 on a stairway landing in the Stanford University Physics Building. I had just been hired as a part-time research associate on the new Klystron Project at a then munificent $90 per month, and was going upstairs to meet the Varians and their small staff. I had heard of the invention of this new electron tube that could generate centimeter waves, but I did not know how it worked, and indeed I had never even seen one. Thus, when I stopped and introduced myself to Russ, he thought the first order of business ought to be an explanation of the principle of the klystron. I remember his saying something like this:

"Just picture a steady stream of cars from San Francisco to Palo Alto; if the cars left San Francisco at equal increments and at the same velocity, then even at Palo Alto they would be evenly spaced and you could call this *a direct flow of cars*. But suppose somehow the speed of some cars as they left San Francisco could be increased a bit, and others could be retarded. Then, with time, the fast cars would tend to catch up with the slow ones and they would bunch into groups. Thus, if the velocity of cars was sufficiently different or the time long enough, the steady stream of cars would be broken and under ideal circumstances would arrive in Palo Alto in clearly defined groups. In the same way, an electron tube can be built in which the control of the electron beam is produced by this principle — bunching — rather than by the direct control of the grid of a triode."

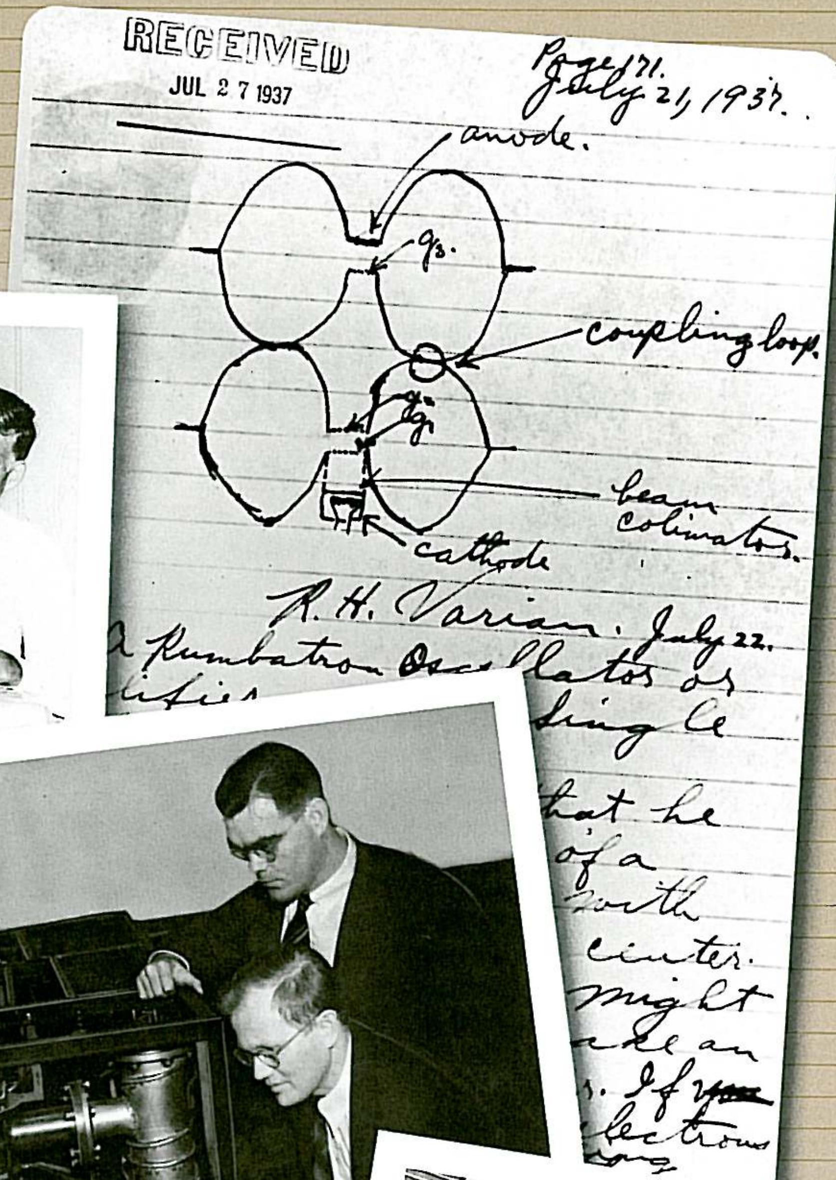
This direct and simple explanation was an inspiring introduction to Russ and to the Klystron Project; it was destined to lead me to a lifetime profession, illuminated by close friendships with Russ, Sig Varian, Bill Hansen, and others at Stanford and, later, at Varian Associates, the company we started.

The Klystron Project was not only an important milestone in electronics, but with the benefit of hindsight, it can be seen as practically a textbook demonstration of the validity of some of today's best known axioms about invention and the "management of technology." It demonstrates, for instance, the wisdom of being "coupled to the marketplace," and of identifying societal or market needs rather than merely advancing technology for its own sake. It also illustrates the benefits of working in a creative research community rather than in small groups or in isolation.

The klystron was invented during the summer of 1937 and announced formally to a world on the brink of war by the Varians in the February 1939 issue of *The Journal of Applied Physics*.

The somewhat diffident announcement was apparently overlooked in Germany — but not in England. Already deeply involved in the development of radar, scientists at Bristol University recognized that this ingenious new development would help make airborne radar possible by providing a lightweight source of microwaves for radar receivers. By late 1940 — just as the Luftwaffe was switching to deadly night bombing — the RAF succeeded in equipping its night fighters with the klystron radar receivers that would help them win the Battle of Britain.

The klystron turned out to be more than an important wartime development, however. It was destined to play an important part in developing the new industry that is now generally referred to as microwave. It helped make commercial air navigation safe, it opened the possibility of worldwide communications for satellites, and it led to a variety of high-energy particle accelerators useful in medicine and in nuclear physics. It thus helped spawn a new technology and then a whole new industry.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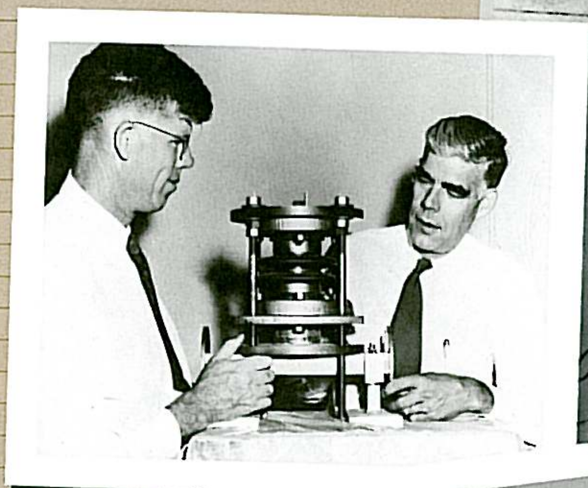
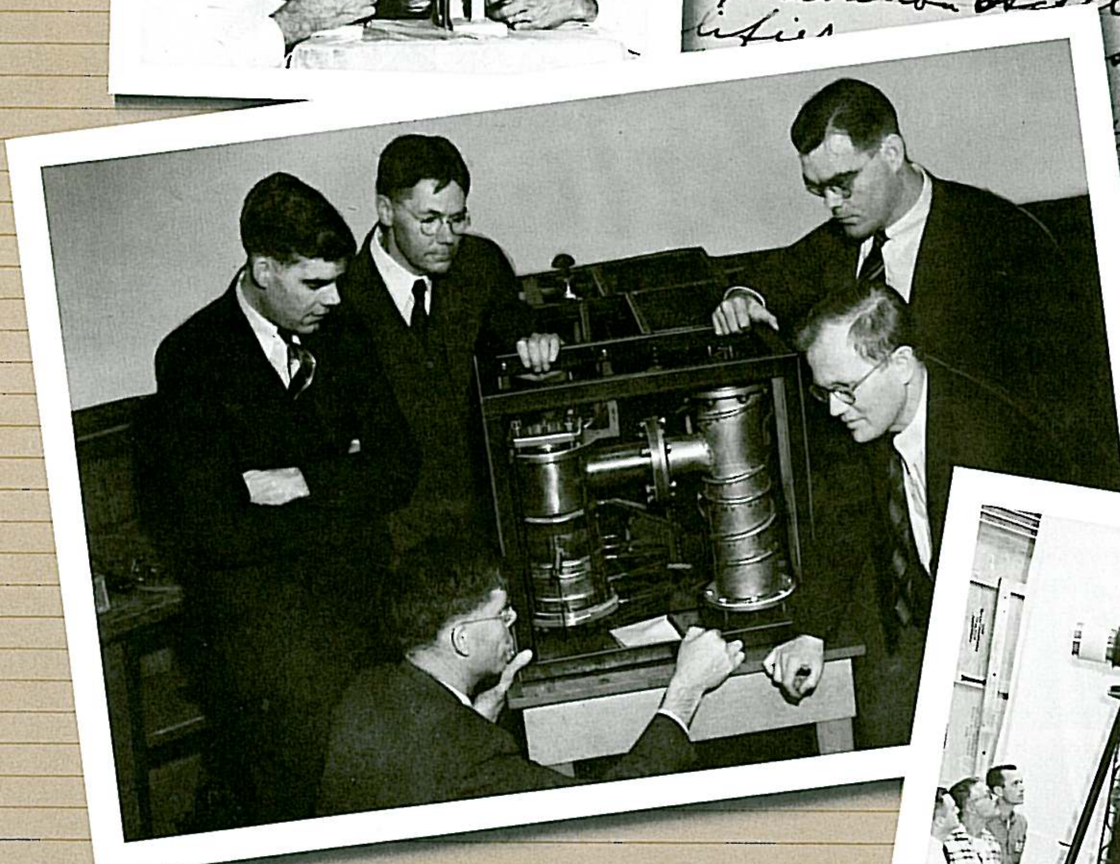
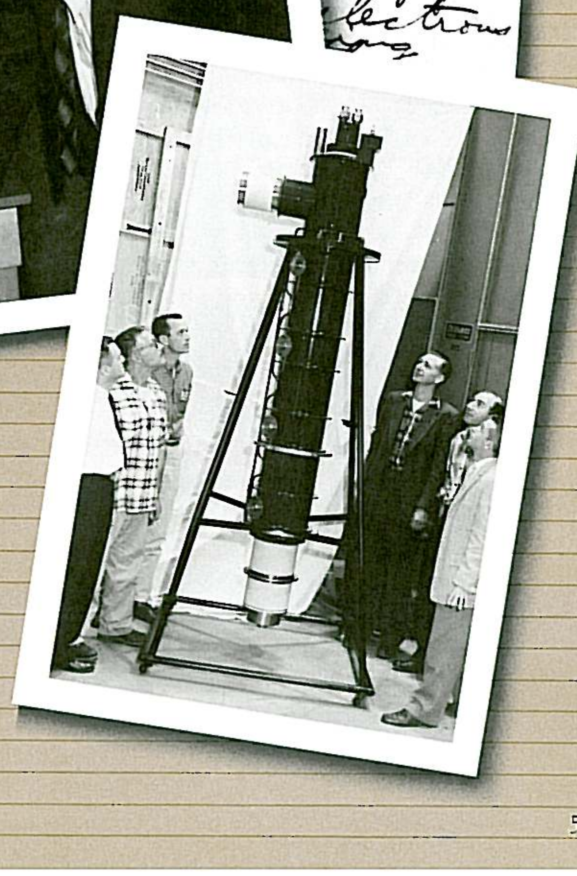






## THE FOUNDING OF VARIAN ASSOCIATES

**By Russell Varian**

WHEN World War II started, the Stanford group was continuing the development of the klystron at Garden City, N.Y. Included among these were Sig and myself, Dr. Edward Ginzton, Dr. W. W. Hansen who divided his time between the Massachusetts Institute of Technology and the Sperry Laboratories, Don Snow, and Fred Salisbury. Myrl Stearns, who was also a Stanford graduate in electronics engineering, joined the laboratory shortly after the move. Californians seem to always want to return to California. There were also some other forces tending to cause us to look longingly at California. One was a considerable misunderstanding of the requirements for the performance of successful research among the administrators where we were.

As time passed, a group of us began to make plans for what we would do after the war was over. We decided that we would return to California and establish a laboratory of our own. There engineers would have a chance to try out their own ideas about how an engineering business should be run.

Shortly before the end of the war, Dr. Hansen returned to Stanford University, largely for health reasons, and Dr. Ginzton accepted an appointment in the Physics Department. I returned to California very shortly after V-J Day and began to actively look around for a location for our new laboratory, and for possible items for development and production. Since the laboratory would be quite small and have limited capital, I more or less eliminated klystrons from the proposed field of our activity. This was because I thought that in order to compete, any company would have to have a considerable number of klystrons, and since I knew that they were quite expensive to develop I did not see any possibility at that time of entering the klystron business. I was very favorably disposed, however, to select some new development in research that we could continue to develop, and that would preferably grow rather slowly so that we could grow with it. As something meeting these requirements, I took a very deep interest in nuclear magnetic resonance which had been developed by Bloch and Hansen at Stanford, and independently by Dr. E. M. Purcell and Professor Robert Pound at Harvard.

We started the company with six full-time employees, consisting of Fred Salisbury, Don Snow, Myrl Stearns, Sig Varian, my wife, and myself. The entire technical and administrative staff consisted of five men, and all the business, financial, and stenographic services centered in Dorothy Varian. Our entire capital consisted of about $22,000.

Dr. W. W. Hansen and Dr. Edward Ginzton were consultants and members of the Board. Also, Dr. Leonard Schiff of the Stanford Physics Department served as a member of the first Board of Directors.

The size of this start was large compared with the size of the original start with the klystron, but it was still very small in personnel and capital compared to our competitors.

We had one stroke of very good luck in getting the R-1 klystron contract almost at the start of our operations. This was a contract proposal that had not met with any enthusiasm from the manufacturers because it had an arbitrary allowance for overhead which was unrealistically low. However this did not, at that time, bother Varian Associates because Dorothy Varian was our entire labor overhead; the rest of us were engineers.

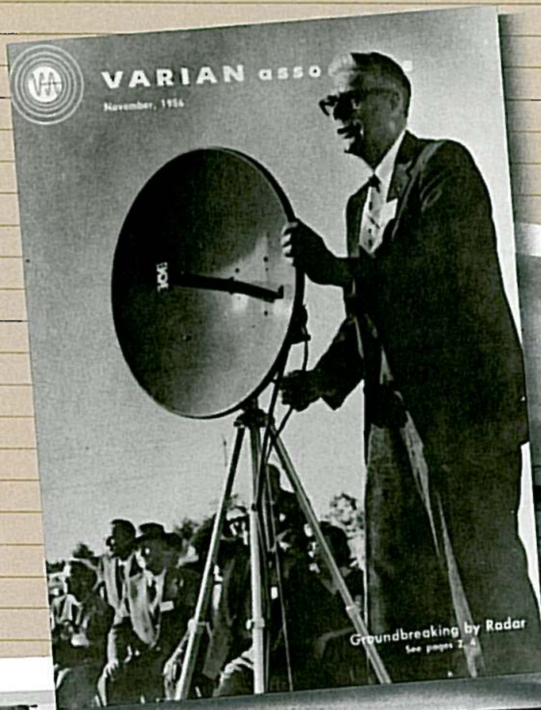
The Company started to grow almost from the start and has continued,

*In 1956, Sig Varian used a dynamite/radar combination to prepare the soil for another Varian facility in Palo Alto.*

*Palo Alto Microwave Tube Division's Building 1 was the first resident of the Stanford Industrial Park in 1953.*

*Pride of workmanship glows on the faces surrounding Varian's first TV tube. Russ and Sig Varian are standing at the back of the group. Some of those in the picture who are still contributing to Varian are Wayne Abraham, Norm Heistand, Darwin Jones, Bruce Nelson, and Stan Schoof.*

*The site of Varian's Palo Alto complex in 1952.*


VARIAN asso
November, 1956
Groundbreaking by Radar

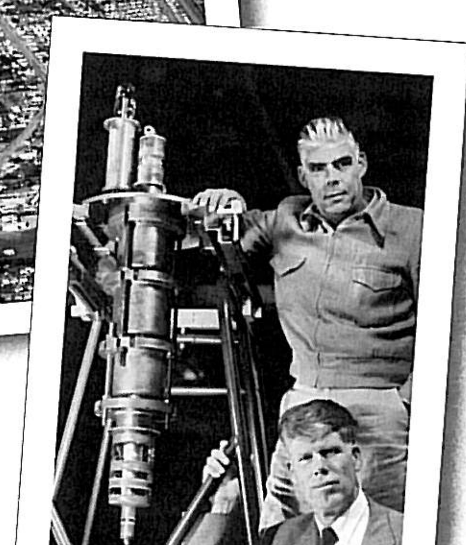
except for a couple of minor recessions, from six people and $22,000 to 1,300 people and a business this year (1958) in the neighborhood of $20 million.

During the ten years between now and then we have managed to reconcile the practical requirements of staying alive and providing for growth with the basic concepts and ideals with which we started. Our primary strength lies in the fact that in pursuing these concepts and ideals, we were able to recruit an exceptionally capable group of people. The millions of dollars worth of equipment and facilities that we have are very essential to our success, but the real thing that makes Varian go is the people that are in the organization.

* * *

The klystron and other microwave devices account for a major portion of the company's business. Currently, millions of dollars in sales are derived from components and systems sold for telephone, radio, TV broadcast, satellite, radar, and other communications applications. Many of these systems are microwave, using Varian klystrons, traveling wave tubes, magnetrons, and solid state devices. In addition, especially in the broadcast area, lower frequency devices such as are made by the Eimac Division power transmitters throughout the world ranging from amateur radio to national radio systems employing million-watt Eimac tetrodes.

*Aerial view of Palo Alto in 1953. Varian now occupies the tract of open land in the center on the left.*



*Russ and Sig Varian (standing) with an early klystron.*

## NMR, THE PHYSICS EXPERIMENT THAT REVOLUTIONIZED CHEMISTRY

A technique which has revolutionized chemistry throughout the world had its origins in experiments carried out on two sides of the North American continent in the late 1940s. As is often the case with basic discoveries in science, the original intent of the work turns out to have been far afield from the ultimate practical application.

Nuclear induction or nuclear magnetic resonance (or simply NMR as it was named by Varian and the name has stuck) was first demonstrated during the winter of 1945-46 by Professors Felix Bloch, William Hansen and their associates at Stanford University, and by another group working independently at Harvard, directed by Dr. E. M. Purcell. The Nobel Prize in Physics was awarded to Bloch and Purcell in 1952 in recognition of the pioneering work in NMR.

Martin Packard was one of Bloch's co-workers at Stanford and joined Varian Associates not long after the founding of the company.

A key figure in making Varian preeminent in NMR, Martin responds to the question: "What does NMR mean to chemistry?" with the reply: "Without it, they'd be out of business." He is perhaps half serious. Rephrasing the question: "What has NMR made possible in chemistry?" he responds:

"Prior to the use of NMR and other less powerful analytical techniques, you could spend literally months and years trying to determine the structure of a molecule. With NMR, infrared, mass spectroscopy, and other such tools, the same problems can often be solved in hours, and the whole field of chemistry has been able to undergo a much more rapid advance and expansion."

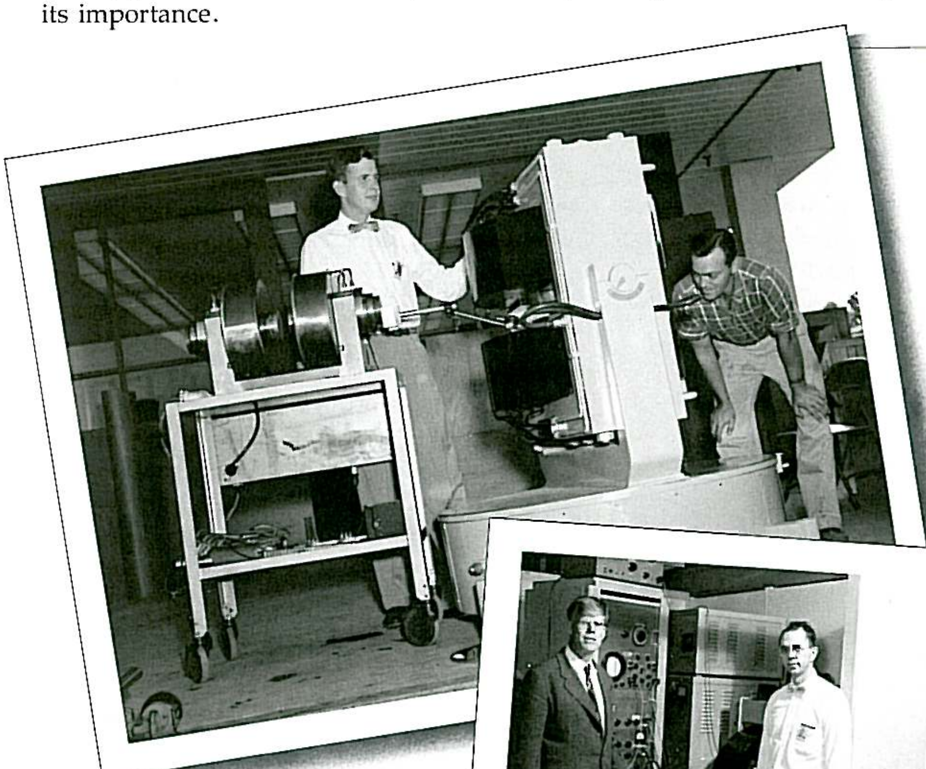
Basically, NMR allows chemists to make structural determinations, to see how a molecule is put together. It answers the question: "What is it I have here?" whether you want the answer in order to eliminate the compound from your product, or because you want to synthesize it and reproduce it, or just because you happen to be curious.

There were two great technical ideas upon which Varian was founded. The first was Russell Varian's velocity modulation concept which led to the klystron. The second was NMR which led to a line of scientific instruments which have opened new doors in chemistry, physics, biology, and medicine. Both ideas had their origins in the Stanford Physics Department. The success of both ideas owed much to the brilliance of the late William Hansen.

The early work in NMR had captured the imagination of Russell Varian who visualized a wide range of possible uses for the process, especially in the fields of chemistry and geophysics. Both Bloch and Hansen viewed their work as an advance in physics theory with little or no immediate commercial value and thus it was the suggestion of Russell Varian that a U.S. patent application be filed to cover this work. An exclusive under the pending application license was granted to Varian in its first year — 1948. The patent was filed only in the U.S because the company was too poor to file in other major countries. Also during this time, Russell conducted an NMR research project of his own which resulted in his obtaining a patent on the use of NMR in measuring the earth's magnetic field. This patent and the license from Bloch and Hansen were subsequently transferred to Varian Associates. He envisioned NMR as possibly the first project that the embryonic company would undertake, but as it turned out, shortly after Varian was incorporated in 1948, there arose a need for stable klystrons, and this took first priority.

It was adventuresome for a fledgling company to try to create a viable business from a concept so esoteric and untried as NMR. And it would not have come off had it not been for the backing of some equally adventuresome chemists at such places as Shell Development Company, DuPont, Humble Oil, and Beyer-Leverkusen in Germany. For the early instruments really did not produce that much valuable data — "you could smell the cork on the bottle and almost make the same analysis," says Martin Packard. But the innovators in the pioneering companies were caught up in the idea of NMR, and bought improved models as they were introduced. Interestingly enough, the early proponents of NMR — almost without exception — became extremely successful professionally, occupying top management posts in their firms.

Today, some laboratories have batteries of NMR systems. Some small laboratories have a single, inexpensive instrument with chemists lined up to use it. They are checking moisture content in food, doing quality control in pharmaceuticals, performing advanced biomedical studies, helping researchers probe the nature of RNA and DNA — the nucleic acids which are the building blocks of human life. They are also in chemistry classrooms everywhere, because to teach chemistry as chemistry is done in the real world, you have to have NMR, and that is probably the best testimony to its importance.



*Chet Carr (l) and Gordon MacFadden (r) with a specially built NMR magnet.*

*Russ Varian (l) and Martin Packard (r) with an early NMR instrument in the first applications laboratory in Building 1.*

THE linear accelerator, a machine which produces x-rays, electrons, and other high-energy particles, has become very much a part of the fabric of our Company. Its inventor and inventor's chief collaborator — Bill Hansen and Ed Ginzton — had worked together with Russ and Sig Varian on the early klystron development and were also instrumental in the creation of Varian Associates. Both were among the original Directors of the Company and both played key roles as technical consultants.

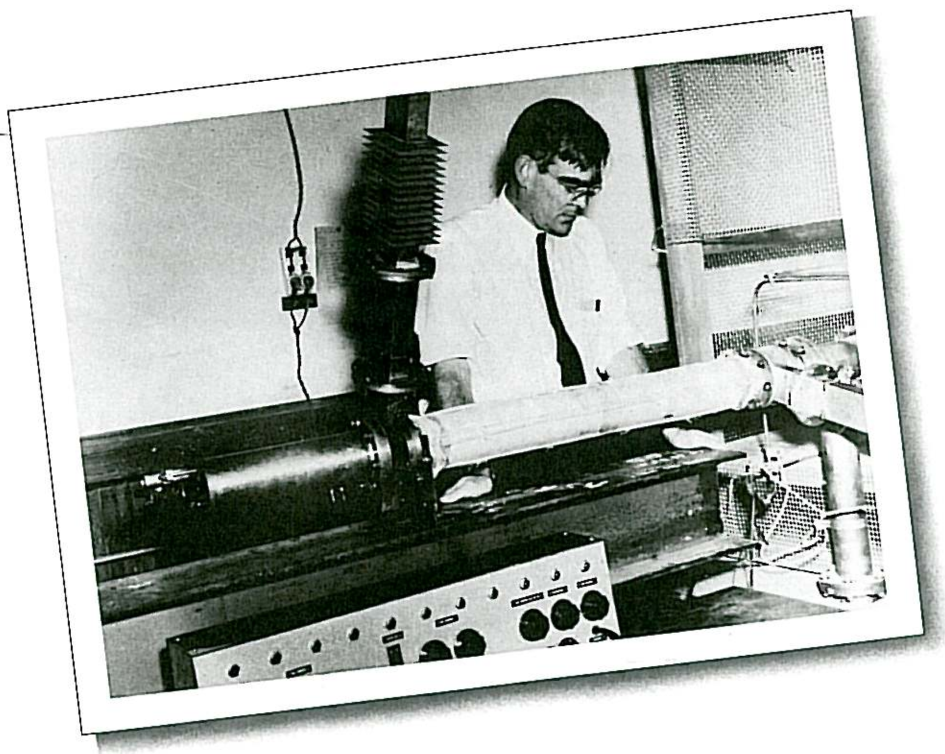
Shortly after the linac accelerated electrons to high energies, its utility for medical applications was explored and brought to fruition. Subsequently, the Clinac® accelerator intended for medical use became a part of the Varian product line, in a large measure through the advocacy of Ginzton.

In the paragraphs that follow, Ed Ginzton describes development of the medical linear accelerator.

"Dr. Henry Kaplan came to Stanford as the head of the X-ray Department in the late 1940s. As a radiologist, he already knew that high-energy x-rays and other particles should be useful in the treatment of cancer. At that time, however, even though high energies could be made available in a physics laboratory, such devices were difficult to use for medical applications and could not be competitive with the radiation then obtained from simpler x-ray machines and from radioactive cobalt.

"Dr. Kaplan had heard of our work on linacs and wondered if they might be useful for medical applications, and so one day in 1951 he came to have lunch with me and discussed his ideas. I became interested at once and undertook an engineering analysis of his requirements. These quickly indicated that what was needed from a medical viewpoint could indeed be accomplished simply with a linac. So, soon, Dr. Kaplan and I decided to collaborate and to build a machine which would be suitable for trial in the Stanford Hospital. I might add that we were not the only ones who began

*William Hansen at work with the linear accelerator.*



to pursue this set of ideas. About the same time in England, several groups began to tackle the idea of treatment of cancer with the linac with a variety of engineering approaches. Our approach, I think, turned out to be the most practical. At the beginning of our work, we clearly could see that there was no problem in being able to produce very powerful x-rays with the linac; the problem was how to make what had been a large clumsy stationary machine into a compact device, easily movable in space, so that the doctor could position it quickly, easily, accurately, and with knowledge that distribution of dosage within the body would be exactly as desired.

"Even though this might sound simple, the realization of a practical machine required some inventions and technical innovations. The big research machines used vacuum pumps which had to be kept in a fixed position and several other components could not be easily moved. Our approach began with the idea that the linac could be built as a sealed-off vacuum tube — just like a high power klystron or a traveling wave tube (the Varian VacIon® Pump was not yet invented — its availability a short time later made it possible for us to make the design of a medical Clinac even more attractive).

"Several graduate students — Arnold Eldredge, Ken Mallory, Karl Brown, and others — and I began to design and build our medical linac. Upon its completion in 1954, it was installed at the Stanford University Hospital in San Francisco and soon became available for use in Dr. Kaplan's department as a new tool in the treatment of cancer.

"The Varian medical linac as we know it today is an elaborate electronic machine consisting of a number of major components: a microwave 'waveguide' — a structure not unlike a high-power traveling wave tube; a high-power microwave source — either a magnetron or a klystron; a highly accurate mechanical support system for the machine and the patient; power supplies; and an elaborate control system. Most of these components and subsystems were things that Varian was expert at from the beginning.

"Once it became clear that Dr. Kaplan's initial treatment of cancer was being successful, it became equally clear to me that there was an unequaled opportunity for Varian. I thought that we could bring the benefits of this pioneering effort to the attention of the medical profession at large, and provide an improved approach to the national struggle against cancer. So, I began to argue with my associates here that the project was ideal for Varian — that it was important, and that we were fully qualified to undertake the major redesign of the medical linac that would be needed for large scale use.

"I now think that the Varian Clinac medical accelerator is one of the most important things that has been accomplished with the aid of electronics. Already it has affected the lives of tens of thousands of individuals — those who have been successfully treated and their families and others close to them. One cannot put monetary value on the savings of lives, or easing of pain.

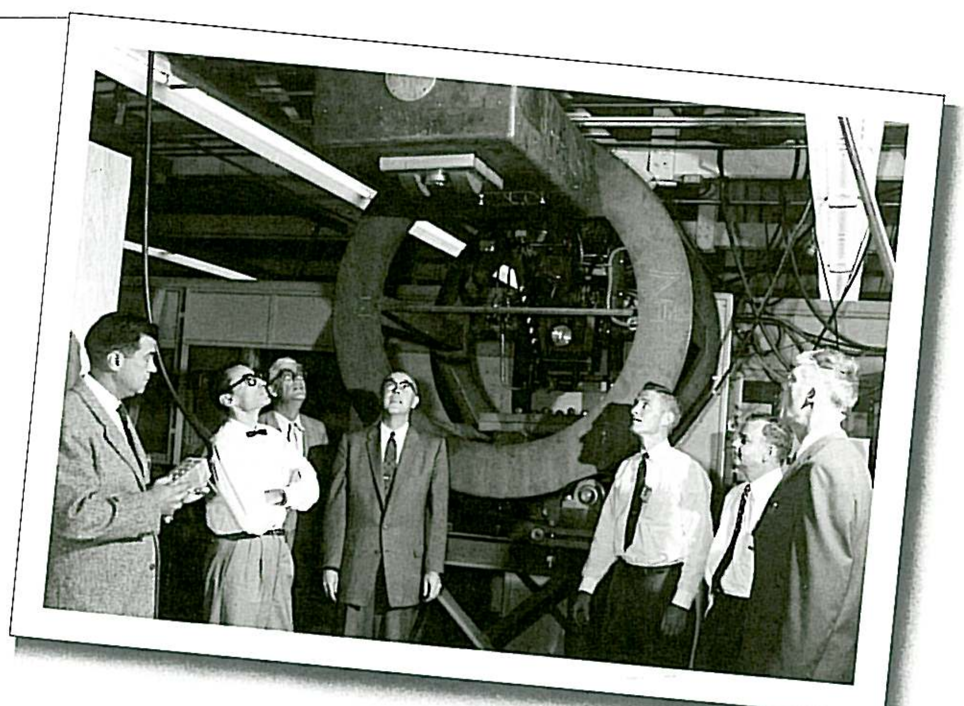
"Even though the Clinac program at Varian was a major achievement, it should be understood that the project was not just a technological success. Varian's success in this instance was due to two things: our technical competence and our patience to persevere in this complex business. Initially, it was easy to sell a few machines because at that time there were a number of doctors ready to explore this new approach to the therapy of cancer. Then, for a number of years, we had a major dry spell. It took a lot of time for the medical profession to demonstrate to itself that the new idea would be a good one, and then to train doctors, nurses, physicists, and therapists to plan the treatment and utilize the machine. This meant that we had to be patient and withstand financial losses for a long time. It was a decade before it was clear that the Clinac would pay for itself. Along the way, there were many who wondered whether the idea was worth it. I think that the development of the medical accelerator is a good example of the mysterious ways in which science can affect our lives. The development of the Clinac was an entirely unforeseen result when viewed from the perspective of the early days and objectives which Bill Hansen had in trying to build a 'microscope' for the study of atoms. (This was also true of the development of the NMR at Varian and for many other inventions which we have worked on — some successful, many promising but now discarded.)

"This project also shows the unique role that a research and development company such as ours — with a highly-trained professional staff, closely related to a university environment, with creative and ingenious technical people — can play.

"In general, it is very difficult to connect up the progress of science with subsequent beneficial results. Surely, one cannot anticipate a one-to-one correspondence between scientific effort and benefits to our society. Of course, there are times when research is conducted for clear utilitarian purposes, but much of research — as was the case in research for the high-power 'microscope' — is not of this practical kind.

"Man's increasing understanding of his environment is the result of his search for the unknown in the physical world and of the laws that govern nature. So, one searches in the world of science for answers to the unknown, never specifically with the hope that such a search would lead to some practical result. However, we know that practical consequences have frequently appeared as a result of man's quest. One can only guess that this will continue to happen in the future. Our work with the Clinac is one such example."

*Gazing up at a deflecting magnet for an early linear accelerator are, from left to right , Fred Wilimek, Bill MacBride, Sig Varian, Emmet Cameron, Bob Avery, Ralph Kane, and Russ Varian.*



*Breaking ground for a new building in Palo Alto are Russell Varian with the shovel and Myrl Stearns driving the tractor.*

*In 1954, the Board of Directors were: (seated around the table from left to right) Ed Ginzton, James Duprau, Garfield Merner, Sig Varian, Francis Farquhar, Myrl Stearns, David Packard, Russ Varian, and (standing from left to right ) Decker McAllister, Ted Moreno, Emmet Cameron, Richard Leonard, and Cliff Heimbucher.*

*In the early days, shareholders' meetings were held in high school auditoriums, community centers or churches. This group of shareholders gathered in 1954.*

IN the beginning, nobody set out to establish a major vacuum manufacturing operation within Varian.

Rather, it was a small Palo Alto Tube Division research project in the mid-1950s that proved to be the vehicle by which the relatively young company would enter the vacuum field.

And it all just sort of happened.

In the early 1950s, as Varian's microwave tube business began to accelerate, the effects of oil contamination on cathodes in tube innards became a significant obstacle to tube manufacturing as well as tube life in the field.

Electron-emitting cathodes are the heart of all microwave tubes, and tube life depends significantly on cathode behavior. Tube life is ended when the cathode "dies."

In an effort to find a means of improving tube life and reliability, the Palo Alto Tube Division in 1956 embarked on a cathode research program aimed at providing greater insight into cathode behavior. It was known that oil backstreaming from the generally used, oil diffusion pumps gave rise to the possibility of oil deposition onto the cathode surface. In order to avoid obscuring effects due to oil contamination, attempts were made to find a "clean," oil-free means of evacuating the cathode test apparatus.

The three-man research team involved with the project consisted of Robert Jepsen, Director of Tube Research; Lewis Hall, who joined Varian specifically for the project from SRI; and John Helmer from Stanford.

Different approaches to getter-ion pumping were explored, and in the course of their research, Hall began experimenting with the technique of gas discharge "sputtering," a more efficient method of vaporizing titanium with which he had had some previous independent experience.

From this work evolved a special pump which Varian designated as a "sputter-ion" pump. "The sputter-ion pump worked well enough to be interesting," recalls Bob Jepsen, "and in an effort to increase the speed of pumping to the point where it would prove useful for laboratory experiments on cathodes, we tried a number of design variations. The most significant of these turned out to be the subdivision of the anode.

"The very first test of what we later called the 'egg crate anode,' " he adds, "showed such a dramatic difference over what had been achieved previously, or what was even expected, that everyone involved became very excited over the pump's performance."

Not only did the higher speed pump prove sufficient for conducting the cathode research experiments the team had set out to do, but it was immediately recognized as a candidate for performing some of the major pumping jobs in other areas that were being handled by diffusion pumps.

"We could see," says John Helmer, "that in addition to eliminating the problem of oil contamination — an achievement we had sought for conducting cathode research — we had developed a pump that had a number of other distinct and useful features as well; it required no cooling water, was easily portable, and the vacuum was not lost in the event of power failure.

"Development of the sputter-ion pump, which was later named the VacIon® Pump, proved to be so much more significant and important than the initial cathode research program that everybody began to work on improving the pump.

"At the time of its development," recalls Helmer, "there were a lot of people at Varian that were not convinced of the practicality and marketability of VacIon pump technology. They could foresee its usefulness in special situations, but they could not see it as a major emerging new technology.

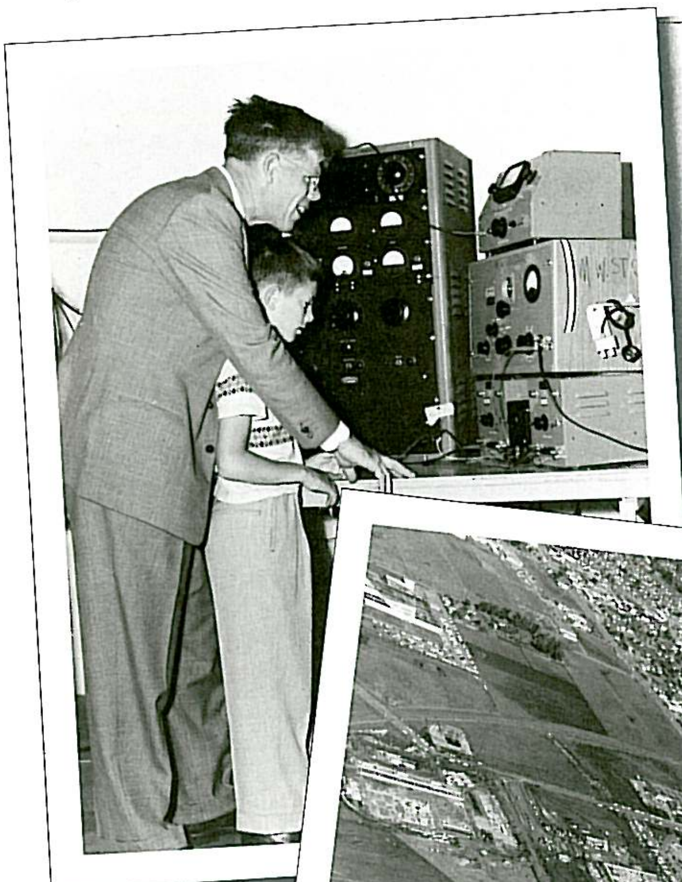
There was some controversy as to whether the VacIon pump was something Varian ought to put its money into for further development and whether the development could support a division."

Nevertheless, the following spring the go-ahead was given to develop "six to eight" prototype pumps, and by summer of 1958, a five-liter-per-second pump was "productized."

In July of 1959, the Vacuum Division was launched as a separate business and by the end of 1959, the first vacuum system was delivered to RCA and the first 5,000-liter-per-second pump was delivered to the Atomic Energy Commission's Oak Ridge National Laboratory for studies of controlled fusion.

Sales volume convinced lingering skeptics, and the Division posted rapid growth in the early 1960s. The development of ultra-high vacuum technology was especially timely for the needs of the NASA space program.

Originally used for research and for vacuum tube pumping, the VacIon pump has spawned a multi-million dollar business for Varian, and the Industrial Equipment Group serves the semiconductor, the packaging, and the automotive markets (to name a few) with sophisticated systems and components.



*Russell Varian and friend study a display at an early Open House.*

*In this aerial view, Building 1 in Palo Alto is complete on the right, Building 2 is under construction in the center, and the Building 3 foundation is being laid on the left.*

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